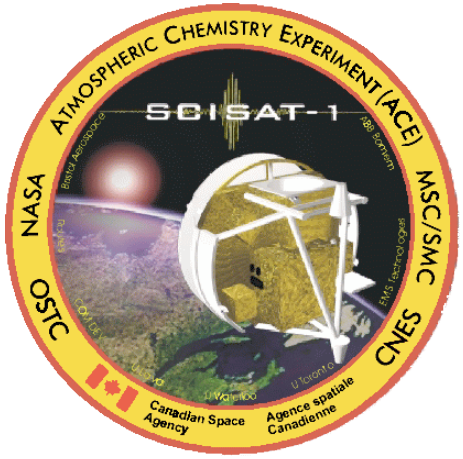


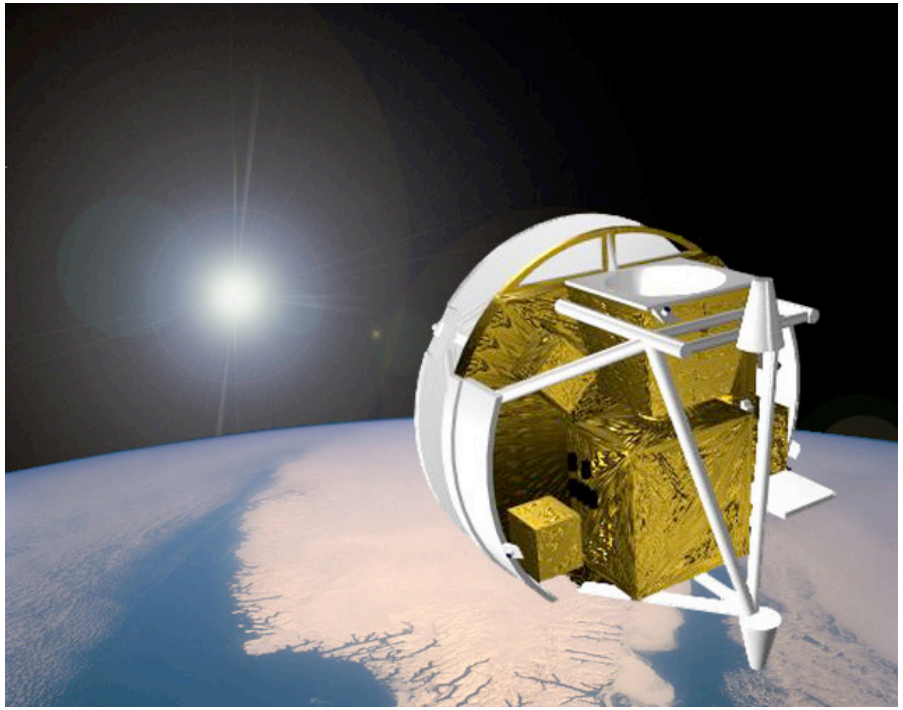
The Atmospheric Chemistry Experiment (ACE): After Four Years In-orbit

Kaley Walker[1,2], Chris Boone[2], Peter Bernath[2,3],
Tom McElroy[1,4], Sean McLeod[2], Ryan Hughes[2]
and the ACE Science and Validation Teams
[1]Physics, University of Toronto, [2]Chemistry, University of Waterloo,
[3]Chemistry, University of York (UK), [4]Environment Canada

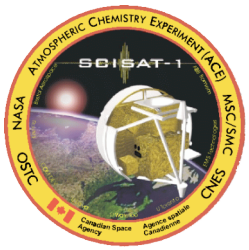
Aura Science Team Meeting - 2 October 2007

SCISAT-1

Goal: to investigate chemical and dynamical processes that control the distribution of ozone in stratosphere and upper troposphere

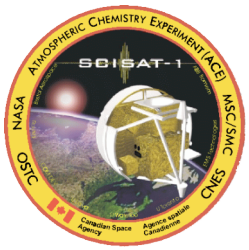


Size:	1.12 m dia. x 1 m
Total mass:	152 kg
Total power:	70 W
(from single solar panel)	
Launch date:	August 12, 2003
Launch vehicle:	Pegasus XL (provided by NASA)
Orbit:	74° inclined circular orbit at 650 km



ACE Mission Status

- Just started 5th year in orbit – designed for 2 year lifetime
- Since launch, satellite and instrument operations nominal
  - Both instruments have been acquiring as much data as possible ~16,700 occultations recorded since January 2004
  - On 1 May 2007, SCISAT-1 completed its 20,000th orbit of the Earth!
- Currently, the only dedicated solar occultation mission in orbit
  - SCIAMACHY on ENVISAT does some occultation
- Extension of ACE mission approved through to end of IPY
  - Until end of March 2009



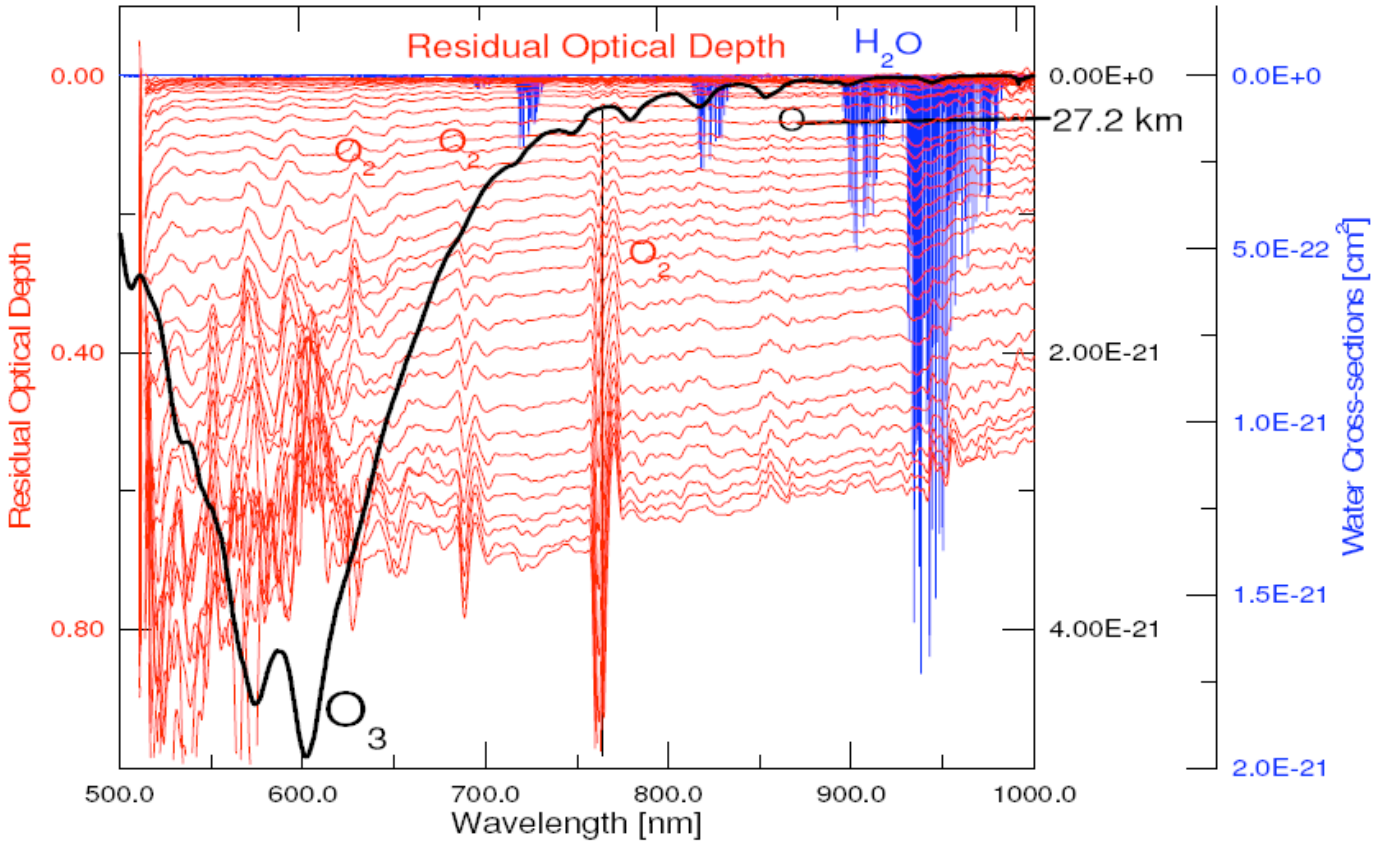
ACE Data Products

- ACE-FTS profiles (version 2.2 + O_3, N_2O_5 & HDO updates):
  - Baseline: O_3, H_2O, CH_4, N_2O, NO_2, NO, HNO_3, HCl, HF, CO, CFC-11, CFC-12, N_2O_5, $ClONO_2$, temperature and pressure from CO_2 lines
  - Other routine: COF_2, CHF_2Cl, CF_4, CH_3Cl, C_2H_6, SF_6, OCS, HCN, HDO
  - Research: CCl_4, HOCl, H_2O_2, HO_2NO_2, CCl_2FCClF_2, CH_3CClF_2, ClO, C_2H_2, N_2 and additional isotopologues
- MAESTRO profiles (version 1.2):
  - O_3, NO_2, and optical depth (available very soon!)
- IMAGERS profiles (version 2.2):
  - Atmospheric extinction at 0.5 and 1.02 microns

Residual Aerosol Extinction

New Product!

- Aerosol optical depth obtained by subtracting molecular signal from fit
- Uncorrected residual from H_2O and O_2 (A, B, and gamma bands)

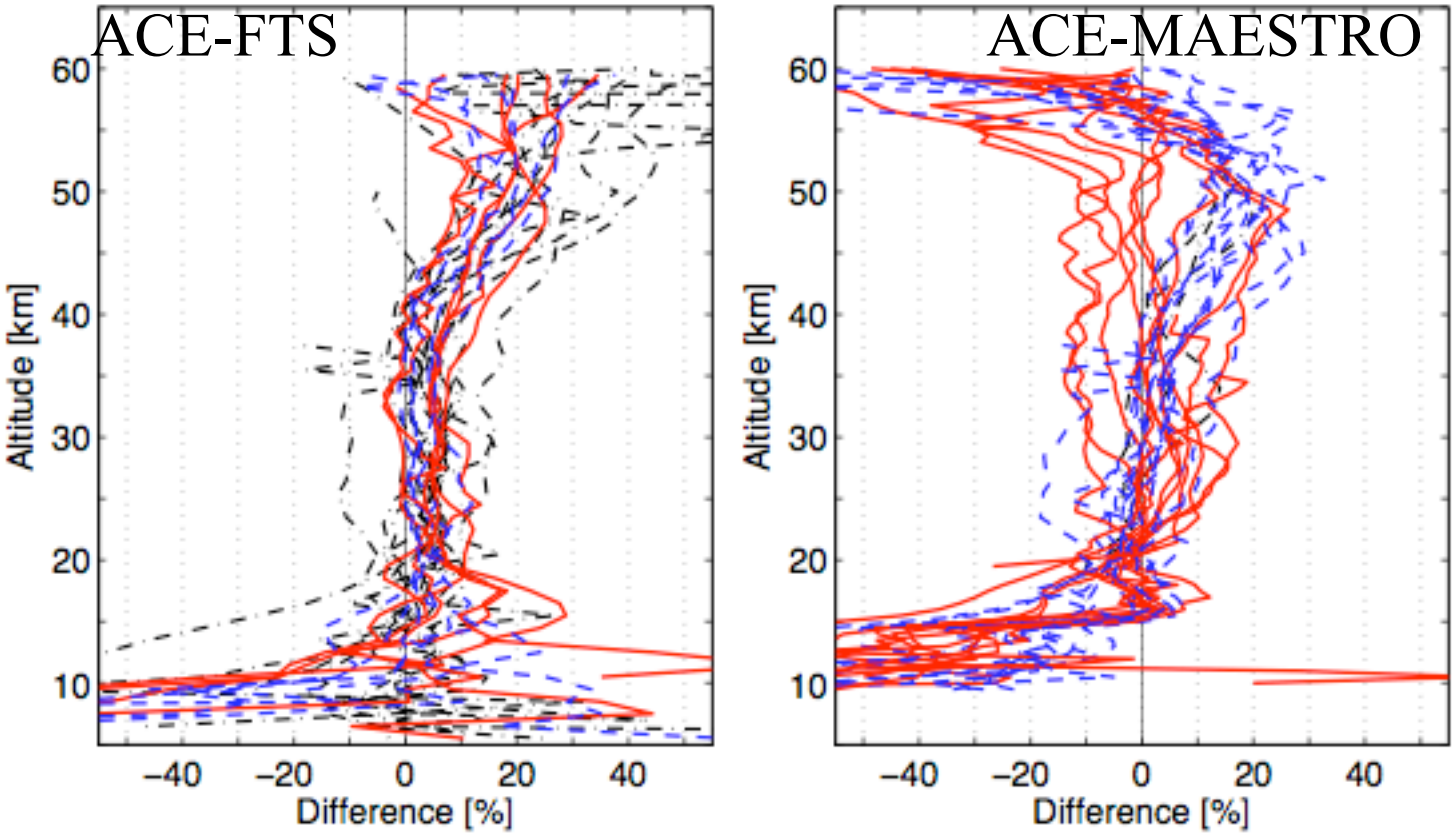


T. McElroy and the MAESTRO team

Ozone Comparisons

Overview of all profile comparisons versus:

SAGE II, SAGE III, POAM III, HALOE, SMR, OSIRIS, MLS, SABER, ASUR, SCIAMACHY, GOMOS, MWR, MIPAS, Eureka DIAL, ozonesondes



Agreement: ACE-FTS +5%; ACE-MAESTRO ±5%

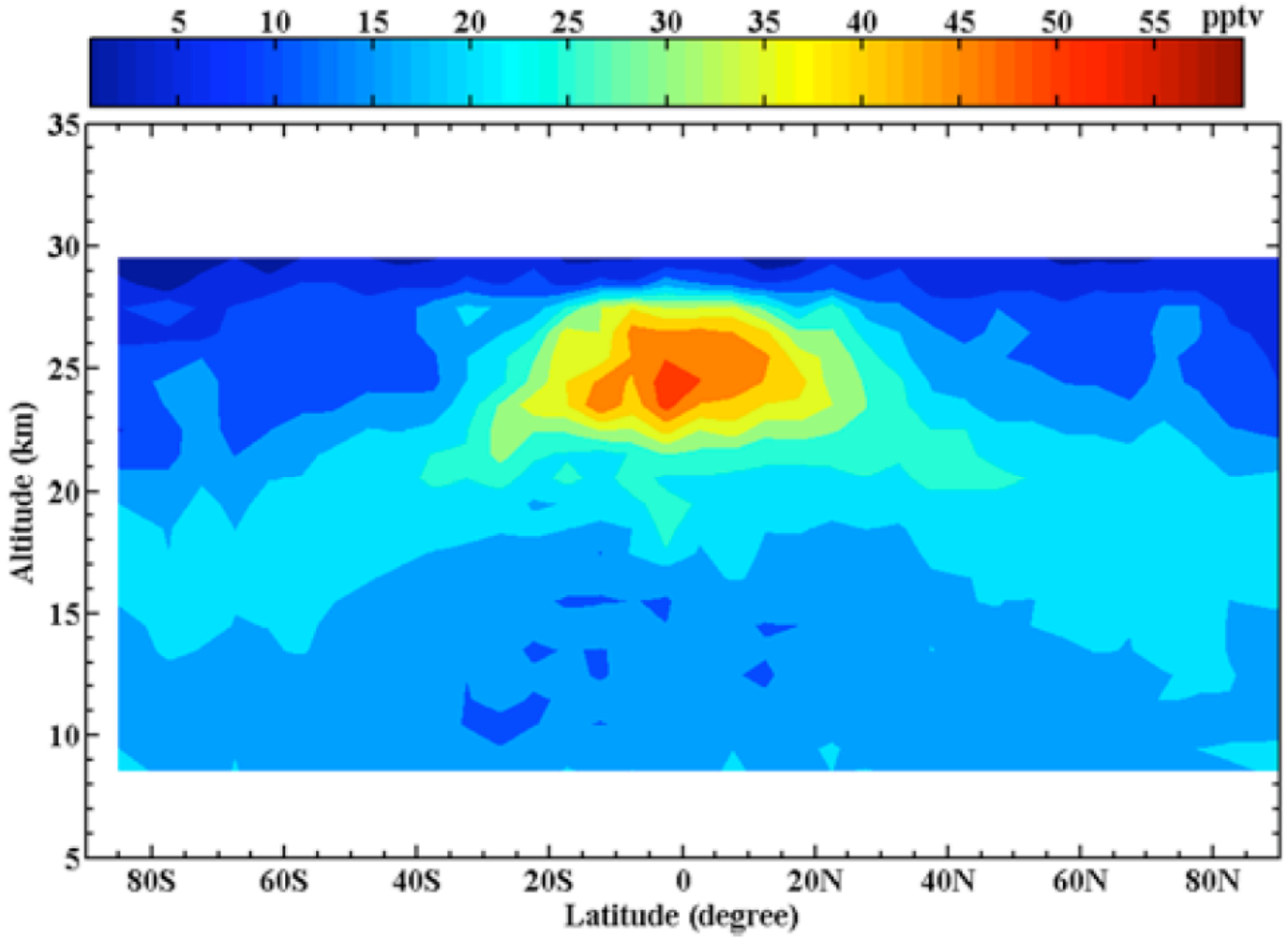
Mean calculated as (ACE-comp)/average:

Solid red: SR; Dashed blue: SS; Dot-Dash black: both SR/SS

E. Dupuy and J. Kar

Distribution of Phosgene ($COCl_2$)

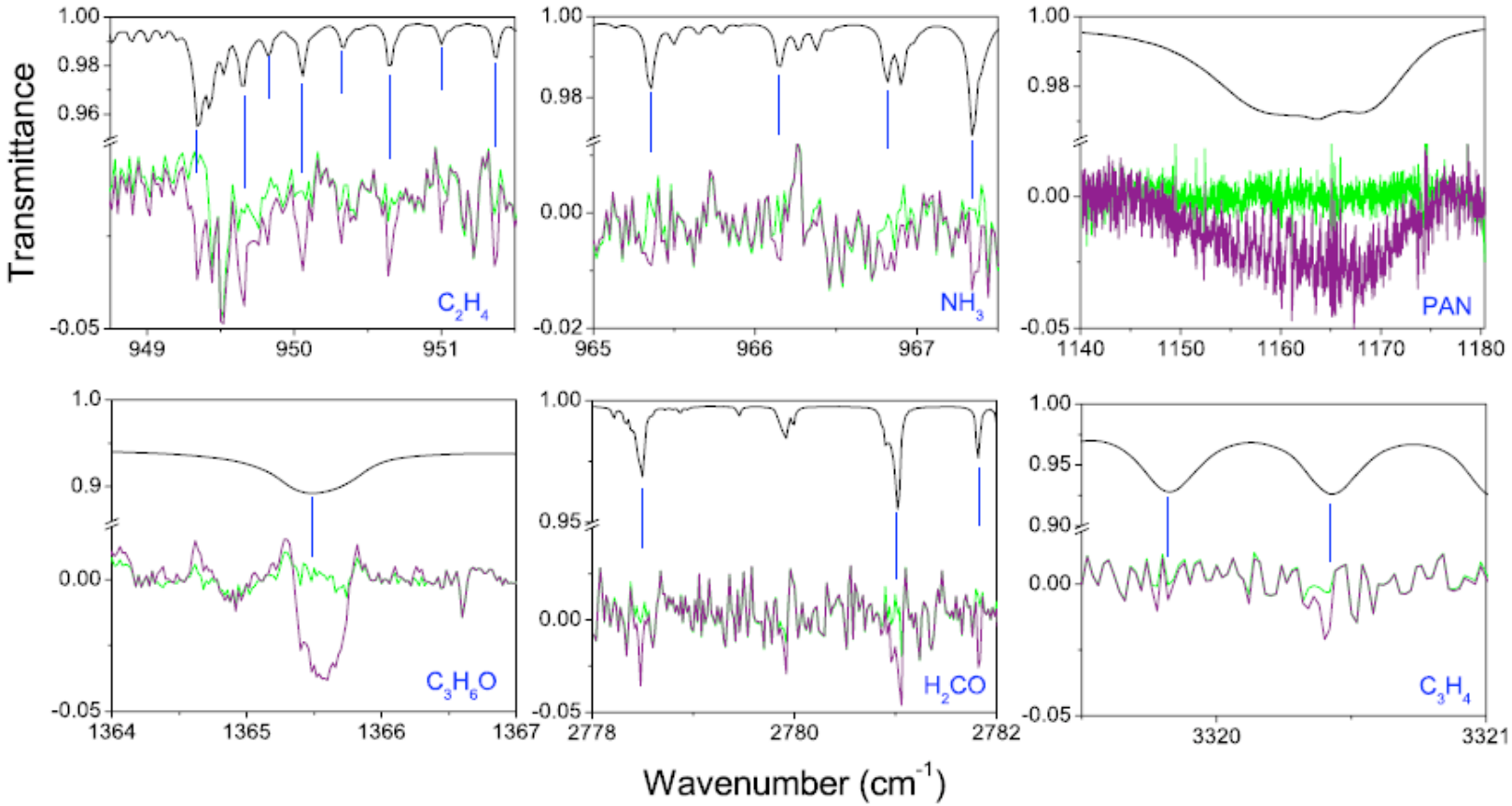
- $COCl_2$ is product of chlorocarbon decomposition
- Previously studied by aircraft (5 - 12 km) and MkIV FTIR on balloons
- First global picture



D. Fu *et al.*, GRL, 34, L17815 (2007)

New Tropospheric FTS Species

- Retrievals from profile taken in young biomass burning plume near East Coast of Tanzania (6.95 S, 39.42 E, 8 October 2005)

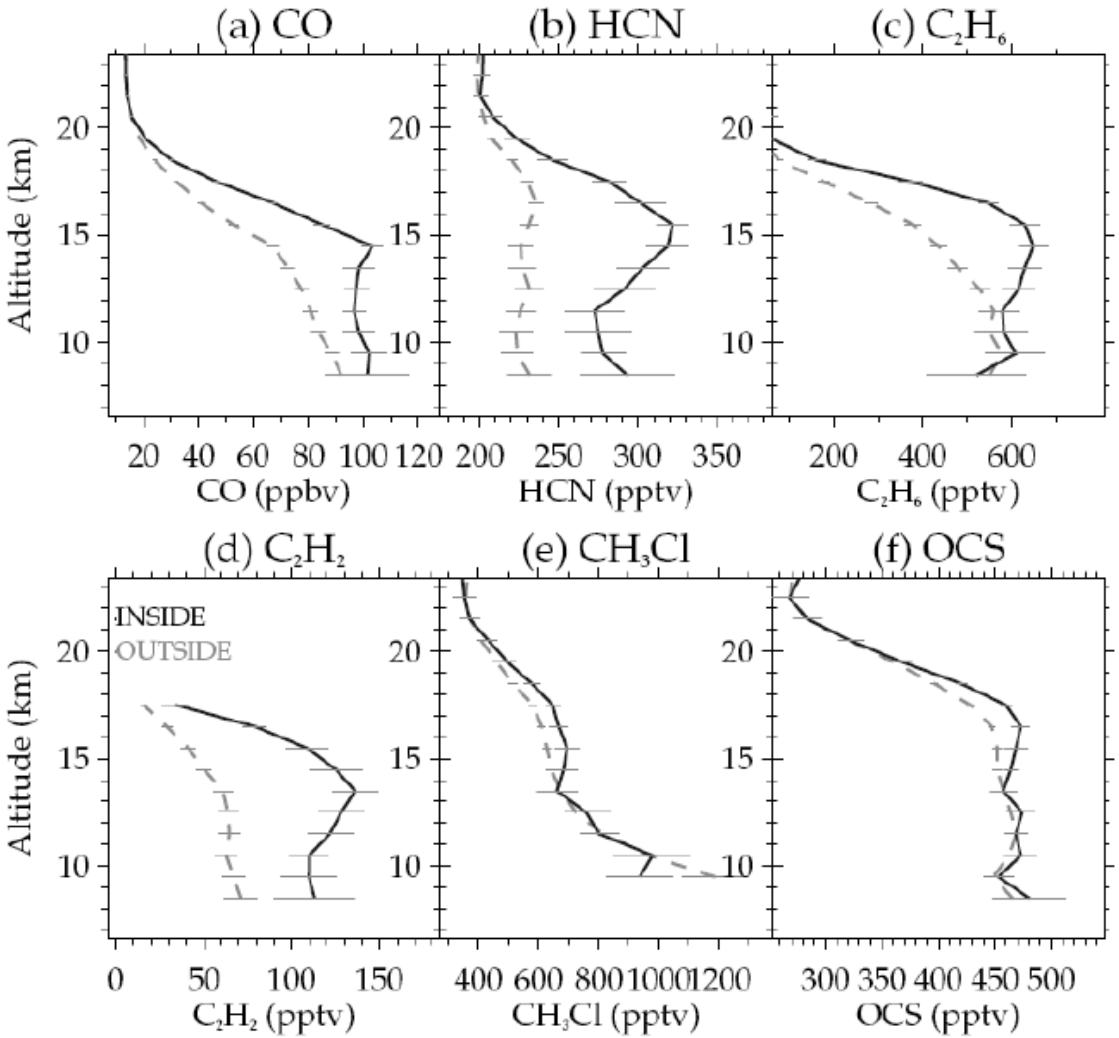


Spectral residuals **without**, **with**

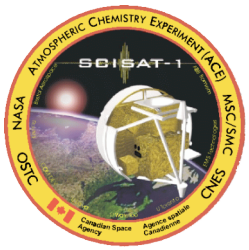
P.-F. Coheur *et al.*, ACPD, 7, 7907-7932 (2007)

Species Isolation in Asian Monsoon

- ACE-FTS profiles from June-August 2004-2006
- Inside/ouside identified using CO threshold where it is >60 ppbv at 16.5 km
- Inside see enhancement of tropospheric species with maximum near ~15 km

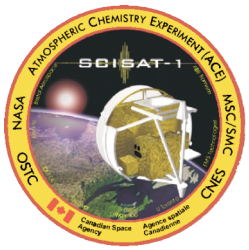


M. Park *et al.*, ACPD, 7, 1–22 (2007)



Summary

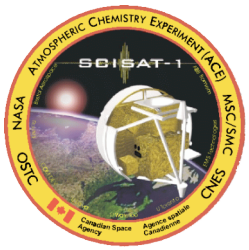
- ACE-FTS and ACE-MAESTRO data being used for scientific studies from tropsphere to mesosphere
  - Reprints available from http://www.ace.uwaterloo.ca
- Validation of v2.2 (plus updates) for ACE-FTS and ACE-IMAGERS and v1.2 for MAESTRO is being completed
  - Focusing on O_3, H_2O, CH_4, N_2O, NO_2, NO, HNO_3, HCl, HF, CO, CFC-11, CFC-12, N_2O_5, $ClONO_2$, temperature, atmospheric extinction
  - Public release of the current ACE data products is planned for the end of 2007



Acknowledgement

Funding for ACE provided by:

- Canadian Space Agency (CSA)
- Natural Sciences and Engineering Research Council of Canada (NSERC)



Working with ACE data

If you are interested in using ACE data…

- Please let me know - we welcome collaborations:

kwalker@atmosp.physics.utoronto.ca

- Current versions are being kept up to date at the AVDC
- Public data release of ACE-FTS, ACE-MAESTRO, and ACE-IMAGER data products, is expected near the end of the year

https://www.ace.uwaterloo.ca/